A THERMOMECHANICAL COHESIVE ZONE MODEL FOR BRIDGED DELAMINATION CRACKS

Ashwin Hattiangadi and Thomas Siegmund

School of Mechanical Engineering,
1288 Mechanical Engineering Building
Purdue University, IN, 47907, USA.

The coupled thermomechanical numerical analysis of composite laminates with bridged delamination cracks loaded by a temperature gradient is described. The numerical approach presented is based on the framework of a cohesive zone model. A micromechanism based traction-separation law is presented which accounts for breakdown of the micromechanisms responsible for load transfer across bridged delamination cracks. The traction-separation law is coupled to heat conduction across the bridged delamination crack. The coupled crack-bridging model is implemented into a finite element framework as a thermomechanical cohesive zone model. Bridged delamination cracks of fixed lengths are studied. Values of the crack tip *J*-integral, and of the crack heat flux are computed to characterize the loading of the structure. Boundary conditions are considered that lead to crack opening either through bending deformation or buckling delamination. The influence of critical mechanical and thermal parameters of the bridging zone on the thermomechanical delamination behavior is discussed. Bridging fibers not only contribute to crack conductance, but by keeping the crack opening small they allow heat flux across the delamination crack to be sustained longer, and thereby contribute to reduced levels of thermal stresses. The micro-mechanism based cohesive zone model allows the assessment of the effectiveness of the individual mechanisms contributing to the thermomechanical crack bridging in dependence of the applied boundary conditions.

Acknowledgements
The financial support from Sandia National Laboratories through the NSF-Sandia Life Cycle Engineering Program is gratefully acknowledged.